MST e-NEWS

July 2010

INSIDE

MST research aids New Mexico small business

A New Mexico Small Business Assistance (NMSBA) project led by Bruce Orler has been selected as a 2009 NMSBA Success Story. Only 9 out of more than 300 NMSBA projects were chosen to receive this recognition.

A partnership of Los Alamos National Laboratory, Sandia National Laboratories, and the state of New Mexico, the NMSBA program connects scientists and engineers with New Mexico businesses in exchange for a state gross receipts tax credit. In 2009, the tax credit was nearly $4.3 million — about $1.9 million for Los Alamos and $2.4 million for Sandia.

Through the NMSBA program, Orler and collaborators David Langlois (MST-7) and Michael W. Blair (EES-14), tested the compatibility of heat transfer fluids with polymeric materials for ThermaSun, a renewable solar thermal energy startup in Taos. Orler's team provided ThermaSun technical assistance with materials selection for a durable heat conversion device prototype, the Thermasaver, that can be connected to existing home heating and cooling systems.

MST-7's Bruce Orler (left) and Larry Mapes ThermaSun president, at the NMSBA banquet.

The success of this collaboration has enabled the company to expand this effort for 2010.

Unlike photovoltaic systems that have conversion efficiencies less than 20%, solar thermal systems can convert up to 80% of the sun's energy into usable heat. However, the solar thermal industry experiences high life-cycle costs due to poor system design and materials component compatibility issues. This has caused a growth barrier in the industry, which has prevented adoption by the general public because of fluid and component failures. Currently, the solar thermal industry

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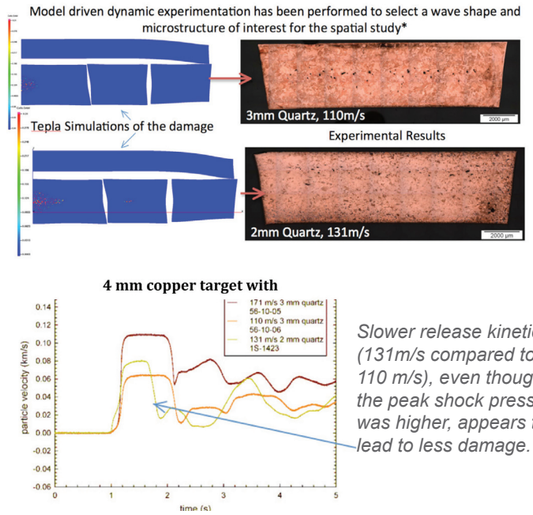
Research… uses fluids that break down at 325˚F while the solar collectors have the capability of reaching temperatures in excess of 400˚F. Simply changing the heat transfer fluid caused unanticipated component failures due to poor compatibility of the plastic components with the heat transfer fluid.

ThermaSun is addressing these compatibility issues to greatly improve reliability and design flexibility, which will bring solar thermal to the next generation by using heat transfer fluids presently unknown to the residential solar thermal industry.

Technical contact: Bruce Orler

Understanding and predicting dynamic damage processes

Ellen Cerreta (Structure/Property Relations, MST-8) and Darcie Dennis-Koller (Shock and Detonation Physics, WX-9) showed that subtle changes in kinetics drastically change the damage evolution of structural metals, specifically copper (see figure). The scientists used electron backscatter diffraction and x-ray tomography to produce three-dimensional data for damage models and to determine the linkages between elastic stiffness, Taylor factor, and void formation. Their findings will be used to advance the understanding of dynamic damage evolution and shed new light on the connection between void nucleation and growth. This physical understanding of damage evolution, specifically kinetic effects, will be incorporated into current damage models, which currently over-predict this type of damage evolution.



Slower release kinetics (131m/s compared to 110 m/s), even though the peak shock pressure was higher, appears to lead to less damage.

(Top): Determination of early stage damage in scoping calculations and gas gun shots of copper targets with quartz impactors. TEPLA is a damage plasticity model. The colored dots on the left side of the simulations indicate void formation. Note the void formation in the 3 mm quartz, 110 m/s experiment. (Bottom): Particle velocity measurements of a copper target with quartz impactor.

The aerospace, nuclear, and automotive industries, and military applications, require materials that can tolerate damage in the extreme environment of dynamic loading. During these events, irreversible mechanical damage or plastic deformation of a material can lead to failure. Elucidating the fundamental mechanisms responsible for this dynamic damage is critical for developing predictive capabilities to understand the physics associated with types of dynamic failures. Scientists include Brian Patterson (MST-7), Veronica Livescu and Ricardo Lebensohn (MST-8), Dean Preston (P-23), Curt Bronkhorst, Benjamin Hansen, and Hashem Mourad (T-3); and Davis Tonks (X-CP). LDRD funds the work.

Technical contact: Ellen Cerreta

Researchers complete Plutonium Sustainment Program milestone for laser welding

Materials Technology: Metallurgy (MST-6) scientists and collaborators from Lawrence Livermore National Laboratory (LLNL) and the UK's Atomic Weapons Establishment (AWE), successfully completed a Plutonium Sustainment Program Level 2 milestone for laser welding.

The fiber laser and fiber beam delivery technology was selected for the welding of nuclear materials. The technology replaces the obsolete pulsed laser welding system in use at Los Alamos and electron beam welding technology historically used at the Rocky Flats Plant. Researchers performed an extensive narrowing of the field among competing high-energy beam technologies, leveraging the expertise of LANL, LLNL, and AWE through an enhanced collaboration. The 6 kW continuous wave fiber laser power supply (technology proven by MST-6) and the development of a hermetically sealed fiber-to-fiber glove box connection has shown laser and optical delivery to be a robust modern solution.

Many hours of beam-on time, extensive laser beam characterization, and weld testing have shown the laser supply to feature high beam quality, and repeatable and reliable performance. Working closely with IPG Photonics, the team designed, built, and testing a hermetically sealed optical connection to provide a reliable, compact means to introduce the high-powered laser beam into a high-purity inert welding glovebox. This fiber-to-fiber connector offers significant improvements to the current technology

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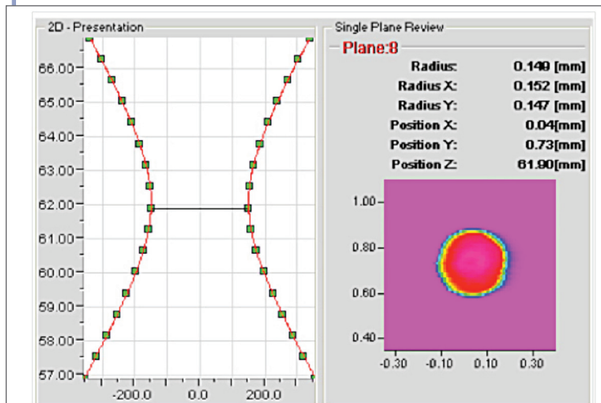
Plutonium… that relies on a rubber boot seal and fixed optical window pass through. Subsequent FY10 Level 2 milestones for this activity will fully integrate these components with advanced process diagnostics, precision motion control, and further demonstrations of welding a wide range of materials. All equipment used is either commercial off the shelf, or custom-built to LANL's specification. Participants in the process development activity milestone include John Milewski, William Stellwag, John Bernal, Gregory Gravener, Thomas Lienert, Paul Martinez, Patrick Hochanadel, Ann Kelly, Robert Forsyth, John Balog and Robert Aikin (MST-6); J. Elmer (LLNL); and J. Vaja (AWE). The Plutonium Sustainment Program funds the research. The LANL Program Director is Robert Putnam, and the Program Manager is Matthew Johnson.

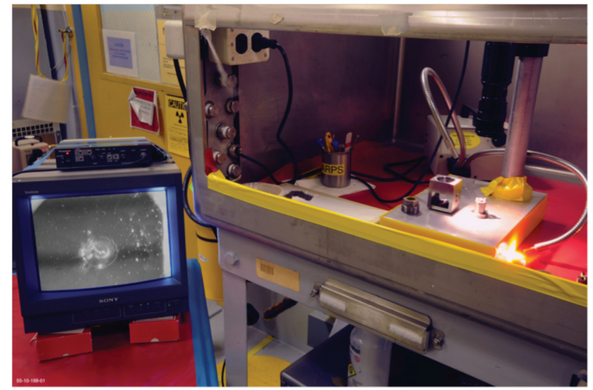
Technical contact: John Milewski



Measurement of spot size and intensity profile at 2 kW for the laser welding method.

Plutonium equation of state experiments under pressure at Advanced Photon Source

The experimentally obtained equation of state of materials under pressure is of importance not only for the validation of models employing theoretical inter-atomic potentials and electronic structure calculations, but primarily to improve our understanding of materials properties under extreme conditions. For plutonium, this data is particularly important to theorists as they struggle to develop a realistic electronic structure model capable of predicting the numerous crystal structure transitions plutonium undergoes in pressure and temperature space. Researchers at Los Alamos are utilizing diamond anvil cell techniques to explore the compressive behavior of plutonium as a function of alloying composition and age. Nenad Velisavljevic (WX-9), James Gallegos (MST-16), and Darryl Lavato (SAFE-4) recently loaded plutonium samples of approximately 10 micrograms in mass. These samples are



Loaded diamond anvil cell located under microscope in fume hood. The plutonium sample is viewable in the monitor to the left. *(Photo by Mick Greenbank of IRM-RMMSO.)*

composed of about 100 grains and were loaded under microscope due to exceedingly its small size – a task made even more challenging by the requirement of handling radiological materials in a fume hood (see photo). After loading, these samples were shipped to the Advanced Photon Source a national synchrotron x-ray research facility funded by the U.S. Department of Energy, Office of Basic Energy Sciences. These experiments provide x-ray diffraction data, fitted to determine crystalline phase, and conducted to temperatures over 800K and pressures over 500kbar. Because plutonium is extremely reactive and samples are mounted in an oil pressure transmitting fluid, mapping pressure-temperature phase space will require a series of similar experiments on similar materials to be conducted. he funding was provided by Dynamic Plutonium Experiments, a collaboration of Campaign 1 (Primary Physics) and Campaign 2 (Dynamic Materials Properties).

Teter takes on new MST leadership role

Dave Teter has been selected as the new MST deputy division leader. Formerly the MST-6 deputy group leader, Teter has experience that spans basic science, nuclear weapons science and manufacturing, and management of a large group within a moderate hazard radiological facility.

According to MST Division Leader Wendy Cieslak, Teter's "in-depth operational experience, technical depth in materials, and programmatic connections with the weapons program, nuclear energy and MaRIE will all be great assets for the division."
Teter joined Los Alamos as a technical staff member in MST-6 after receiving his PhD in metallurgical engineering from the University of Illinois at Urbana-Champaign, in 1996. He has served as weapons

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Teter... project leader for metals issues and project leader for the Enhanced Surveillance CSA/Case effort, which focuses on understanding and quantitatively predicting lifetimes of materials, components and assemblies.

He has been part of teams that have received Awards of Excellence for Nuclear Weapons Program and Stockpile Stewardship and was the MST capability champion in metallurgy and metals processing in 2007. Teter is also a member of the Materials Science and Engineering Alumni Board at the University of Illinois's where he works with members of the alumni association to support the continual development of high level teaching, research and public service by the students and faculty in the Materials Science and Engineering program.

MST members recognized for pollution prevention efforts

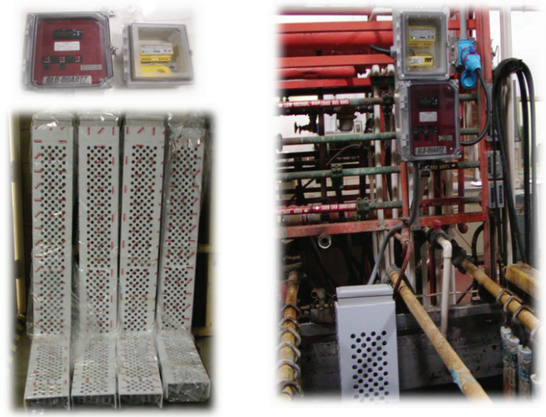
Members of MST were recently recognized with Pollution Prevention (P2) Awards for their efforts in pollution prevention and cleanup projects.

Randall Edwards, Dane Knowlton, Mike Mauro, Jennifer Lillard, Tim Tucker (MST-6); Stephen Trujillo and Roberto Wingo (C-CDE) won an award for "Sigma Electroplating Discharge Reduction." The team managed the replacement of the vacuum pump for the electroplating solution rinse water recycle system and the removal of steam heating for electroplating baths resulting in significant energy, water, and waste savings derived from operations at the Sigma Electroplating Laboratory. Replacing the steam heat system with local resistive heaters will result in annual savings of about 250,000 gallons of potable water while reducing a low-level radioactive liquid waste stream by approximately 850,000 liters. The institutional savings for not treating the waste stream is approximately $1.2 million.

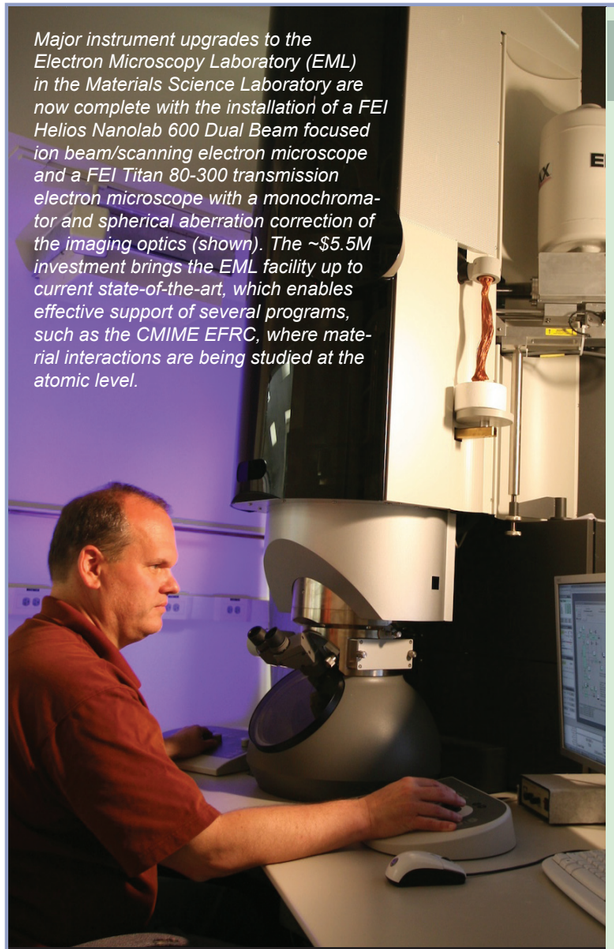
The project required engineering design for the resistive heaters; mapping and upgrading the facility electrical supply/distribution system; structural support for the heaters requiring special materials to be used in a corrosive environment; heater installation and testing; followed by heater refurbishment due to fabrication errors by the vendor and subsequent reinstallation and testing. In addition, with a local supply of heat to the baths (rather than from the steam plant), the electroplating facility's operational flexibility and responsiveness is greatly improved.

Brent Espinoza, Stevan Pattillo (MST-7); Darryl Garcia (WES-WGS); and Phillip Martinez (W-13) were recognized for "Electro-Chemical Laboratory Gets a Makeover." Hazard reduction goals stimulated the cleaning of acid baths and other chemical waste at the Electro-Chemical Laboratory in the Target Fabrication Facility. Approximately 15 55-gallon containers and 10 5-gallon containers of neutralized corrosive acids were eliminated. The estimated weight of this waste was 2,300 kg.

The P2 awards recognize individuals or teams whose efforts over the past fiscal year have eliminated or minimized waste or pollution; conserved resources; procured green or environmentally preferred products; applied sustainable design principles; or identified other ways to reduce risk, save money, and enhance the Laboratory's mission. More than 300 award recipients were recognized for their efforts on 60 pollution prevention and cleanout projects.



The electric heaters above have replaced steam heaters in the chemical tanks of the Sigma Electroplating Laboratory. Previously, condensate from the steam heaters was sent down the RLW as waste. The electric heaters reduce the annual discharge to the RLW by approximately 850,000 liters, which saves about $1.2 million in waste treatment costs.



Major instrument upgrades to the Electron Microscopy Laboratory (EML) in the Materials Science Laboratory are now complete with the installation of a FEI Helios Nanolab 600 Dual Beam focused ion beam/scanning electron microscope and a FEI Titan 80-300 transmission electron microscope with a monochromator and spherical aberration correction of the imaging optics (shown). The ~$5.5M investment brings the EML facility up to current state-of-the-art, which enables effective support of several programs, such as the CMIME EFRC, where material interactions are being studied at the atomic level.

Celebrating service

Congratulations to the following MST Division employees celebrating service anniversaries this month:

Carl Trujillo, MST-8	25 years
Mark Bourke, MST-8	20 years
Kendall Hollis, MST-6	15 years

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To submit news items or for more information, contact Karen Kippen, EPS Communications, at 606-1822, or kkippen@lanl.gov.

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HeadsUP!

Know your MST Electrical Safety Officers

MST-6: Greg Gravener and Dane Knowlton
MST-7: John Charles
MST-16: Michael Ramos

IWM Toolbox site features pre/post job guidance

Conducting moderate or high hazard/complex work? Then you should check out the Web site devoted to pre-job briefings and post-job reviews.

Pre-job briefs are required by P300, Integrated Work Management, for all moderate and high hazard/complex work activities. Pre-jobs should be conducted preferably right before work starts, and as frequently as necessary when:

- Assignments have changed or new personnel are involved which may be an individual, specific pre-job briefing,
- A change in work scope, R&D boundary/limits, and/or in facility or work area conditions has occurred that may affect safety, security, or the environment, or
- Work activities are resumed after an extended period of inactivity.

Post job reviews and capturing lessons learned are required by P300 when an activity is terminated or fully completed and the IWD or equivalent work control document is no longer needed. For ongoing activities, post job reviews, feedback or lessons learned should be obtained during the normal course of the work by completing Part 4 of the IWD.

A good refresher for persons-in-charge (PICs) and a good start for new PICs, the Web site features a 30-minute video, briefing and review guides and checklists. Find it at int.lanl.gov/safety/iwmc/.